

National Travel Time Data Processing and Utilization

Wenjing Pu

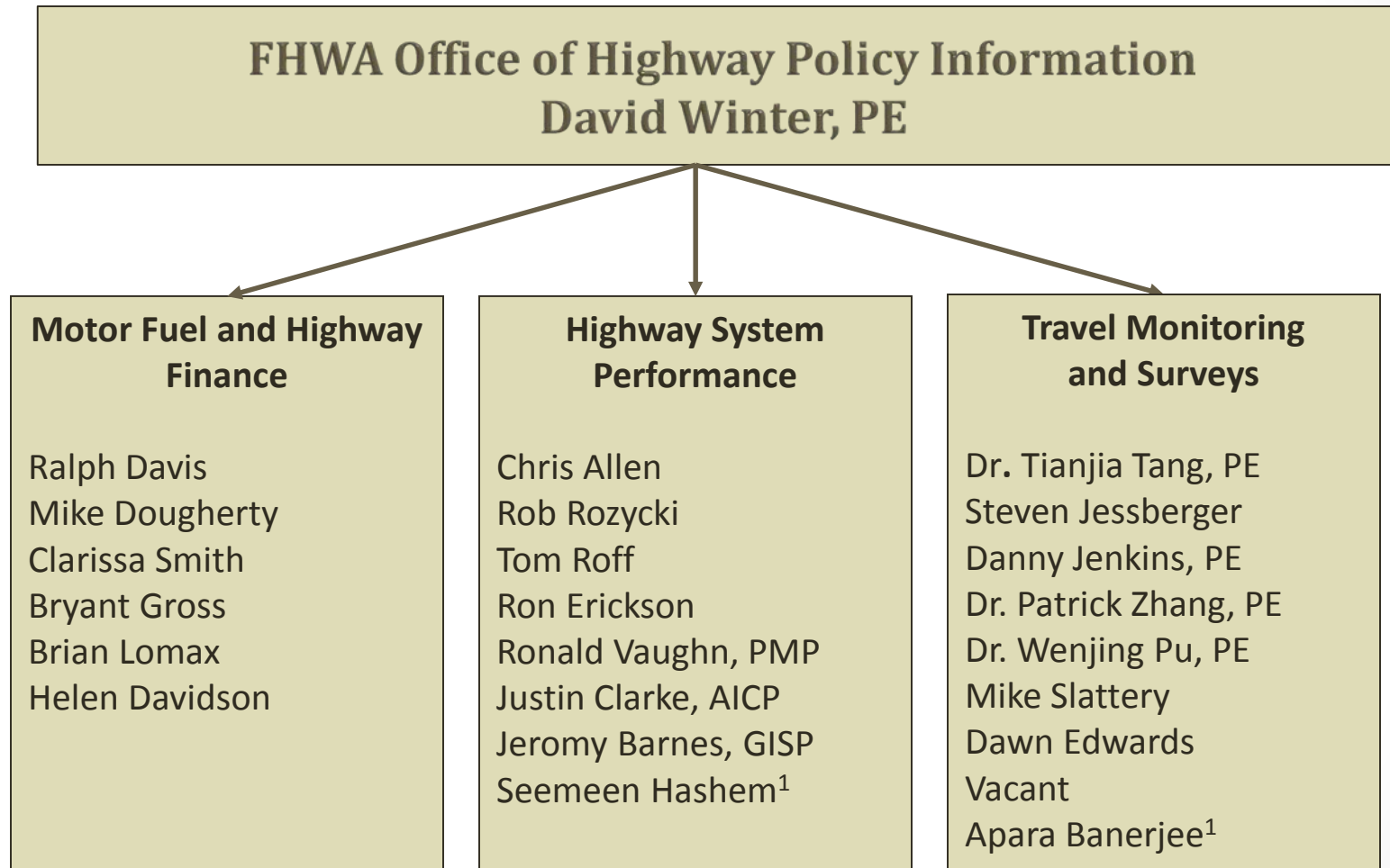
Highway Information Seminar

November 13, 2017

11/13/2017



Office Organizational Chart



1 – Indicates contractor



Outline

1. National Performance Management Research Data Set (NPMRDS)
2. NPMRDS for PM3 (System Performance, Freight, and CMAQ)
3. NPMRDS for Other Applications



Part 1

NPMRDS



Topics

- Overview
- Access to NPMRDS
- Data Structure
 - Speed/travel time (.csv)
 - TMC Identification (.csv)
 - TMC shapefile
- NPMRDS/HPMS Conflations



What is NPMRDS?

- A package of vehicle probe data procured by FHWA
 - 1st procurement (NPMRDS v1): July 2013
 - 2nd procurement (NPMRDS v2): April 2017
- Archived travel time and speed; AADT (if available) is conflated from HPMS
- Resolution: 5-minute intervals on over 400,000 TMC segments
- Coverage: National Highway System, 26 border crossings
- Travel time and speed by vehicle type:
 - Passenger vehicles
 - Trucks
 - All (passenger vehicles and trucks)



NPMRDS: v1 vs. v2

	V1	V2
Data Vendor	HERE	UMD-INRIX-TTI-KMJ-IDAX
Temporal resolution	5-minute	5-, 10-, 15-, 60-minute
Epoch w/o obs.	Not included in the file	Has the option to include empty (null) values
TMC Path	Combined TMCs	Internal/External TMCs
Path Processing	No	Yes
GIS Shapefile	HERE LinkID TMC Look Up Table	TMC path 15 HPMS Data Items
Data Download	Multi-States/US; large files	Flexible, Customized selection
Temporal coverage	2011 – 1/31/2017	2/1/2017 – (up to 12/31/2021)





How do I access the NPMRDS?

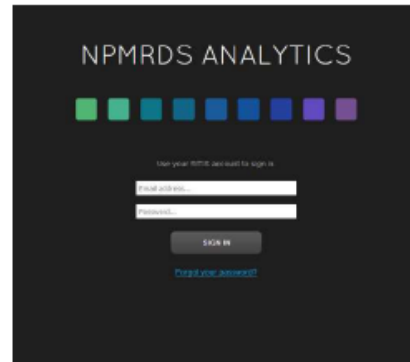
Step 1 – Sign the Data Sharing Agreement	Step 2 – Create a RITIS Account
<p>Before anyone can access the National Performance Metrics Research Data Set (NPMRDS), your organization must execute a data sharing agreement.</p> <p>If you are a public agency, an individual authorized to execute the agreement can sign on behalf of your agency. Afterward, everyone within that agency will be granted access via his or her account.</p> <p>If you are a consultant or contractor, the agency you are working for must execute a data sharing agreement, then your organization must a separate data sharing agreement. Afterward, you will be granted access.</p> <p>The data sharing agreement can be found here: https://npmrds.ritis.org/dsa</p> <p>Questions regarding the data sharing agreement can be sent to npmrds@ritis.org</p>	<p>Access to NPMRDS is granted via a RITIS account. If you do not have one and your organization has executed a data sharing agreement, you can request a RITIS account here: https://www.ritis.org/register/ Note: it may take up to two days to process your request.</p> <p>For the new NPMRDS, every user at an organization must have his or her own RITIS account. Shared logins will not be permitted.</p> <p>Questions regarding RITIS accounts can be sent to: npmrds@ritis.org</p> <div data-bbox="1286 851 1634 1028" data-label="Image"> </div> <p>NOTE: Vendors will need to verify your completion of Step 2 prior to agency receiving access. (This is not immediate, as it requires staff verification.)</p>
<p style="text-align: center;">Step 1 needs to be completed once per organization, only.</p> <p style="text-align: center;">Step 2 must be completed by every individual that will access the NPMRDS.</p>	

Step 3 - Accessing the Data

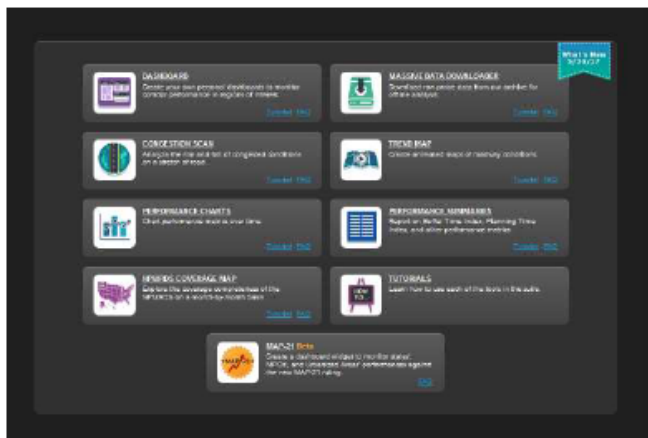
Visit <https://npmrds.ritis.org>

Log in with your RITIS Account

If you have questions or need support please contact npmrds@ritis.org



After logging in to NPMRDS, you will see a landing page with various options. You will use the Massive Data Downloader to download the NPMRDS.

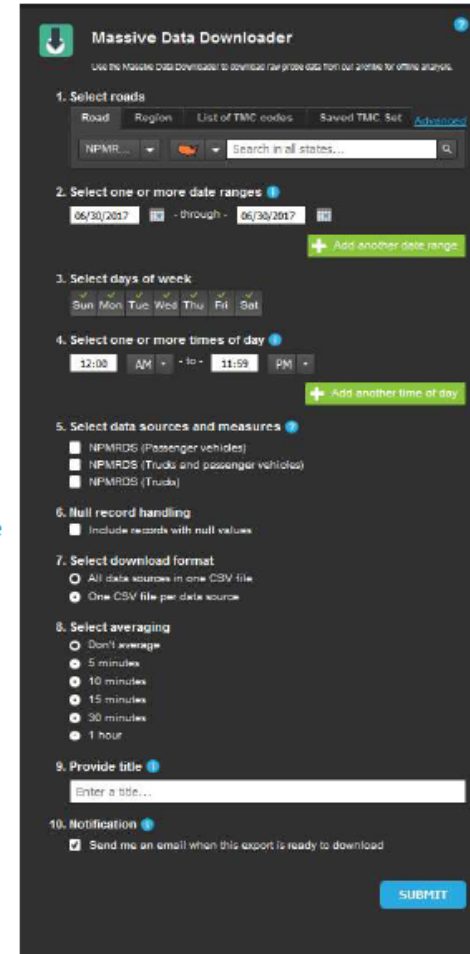


Step 4 - Massive Data Downloader

The Massive Data Downloader is the interface for customizing data parameters and downloading your data.

Data can be customized by geography, dates, days of the week, times of day, modes, and averaging methods.

Monthly data will be available on the fifth business day of the following month (e.g. July 2017's data will be available on August 7, 2017).



Please see the NPMRDS tutorials at <https://npmrds.ritis.org> for more in-depth guides for usage.

Please contact npmrds@ritis.org for support, questions, or concerns.

Live Demo

<https://npmrds.ritis.org>

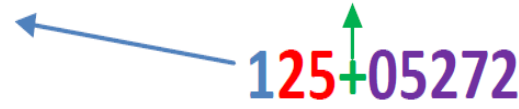
- NPMRDS FAQs
- NPMRDS Descriptive Metadata Document (.pdf)
- Massive Data Downloader
- NPMRDS Coverage Map
- NPMRDS Shapefiles



Interpreting TMC Codes

Country Code

Internal/External Path and Direction

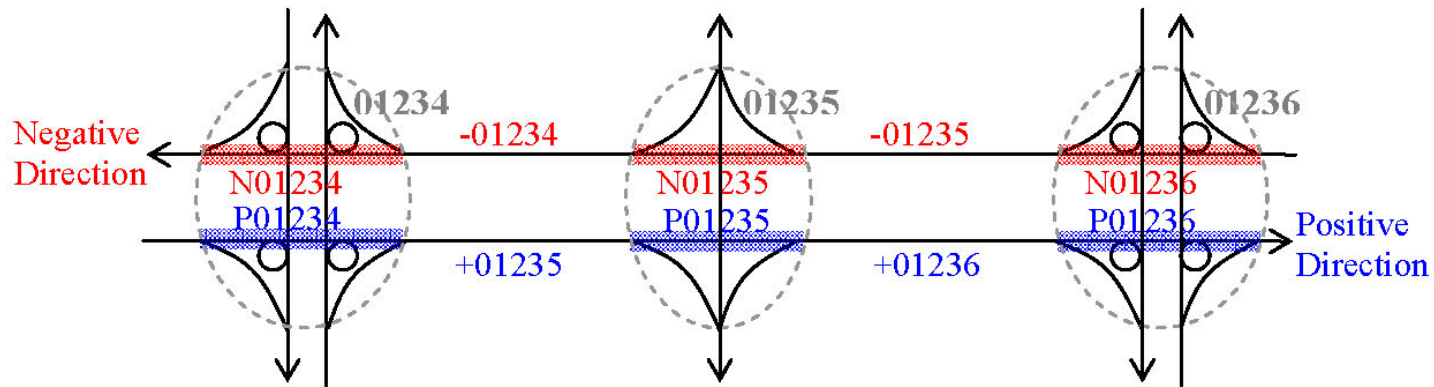


Location Table Name

Location ID



Internal and External TMC Paths



“P” = Northbound or Westbound, internal segments

“N” = Southbound or Eastbound, internal segments

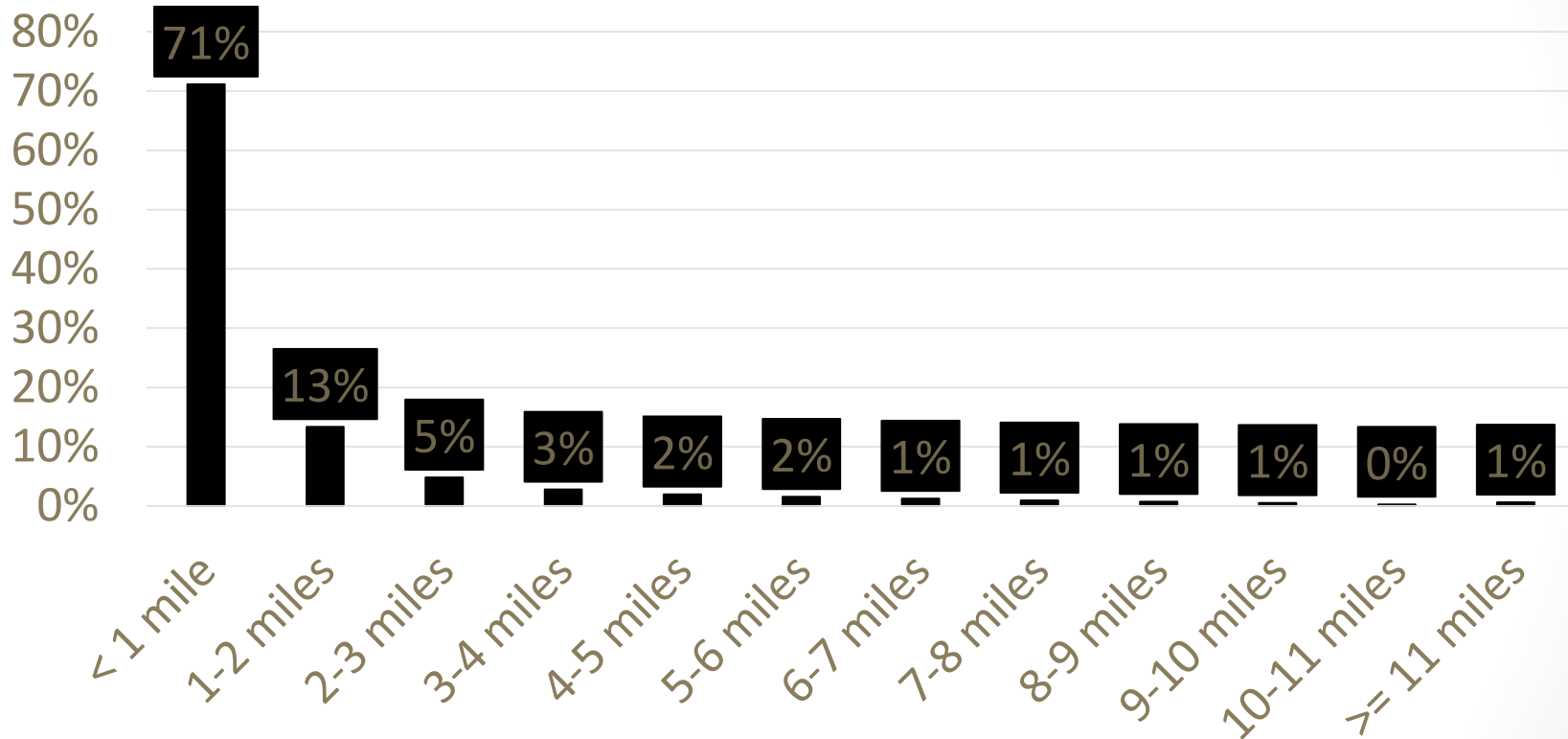
“+” = Northbound or Westbound, external segments

“-” = Southbound or Eastbound, external segments



TMC Lengths

NPMRDS v2 TMC Lengths

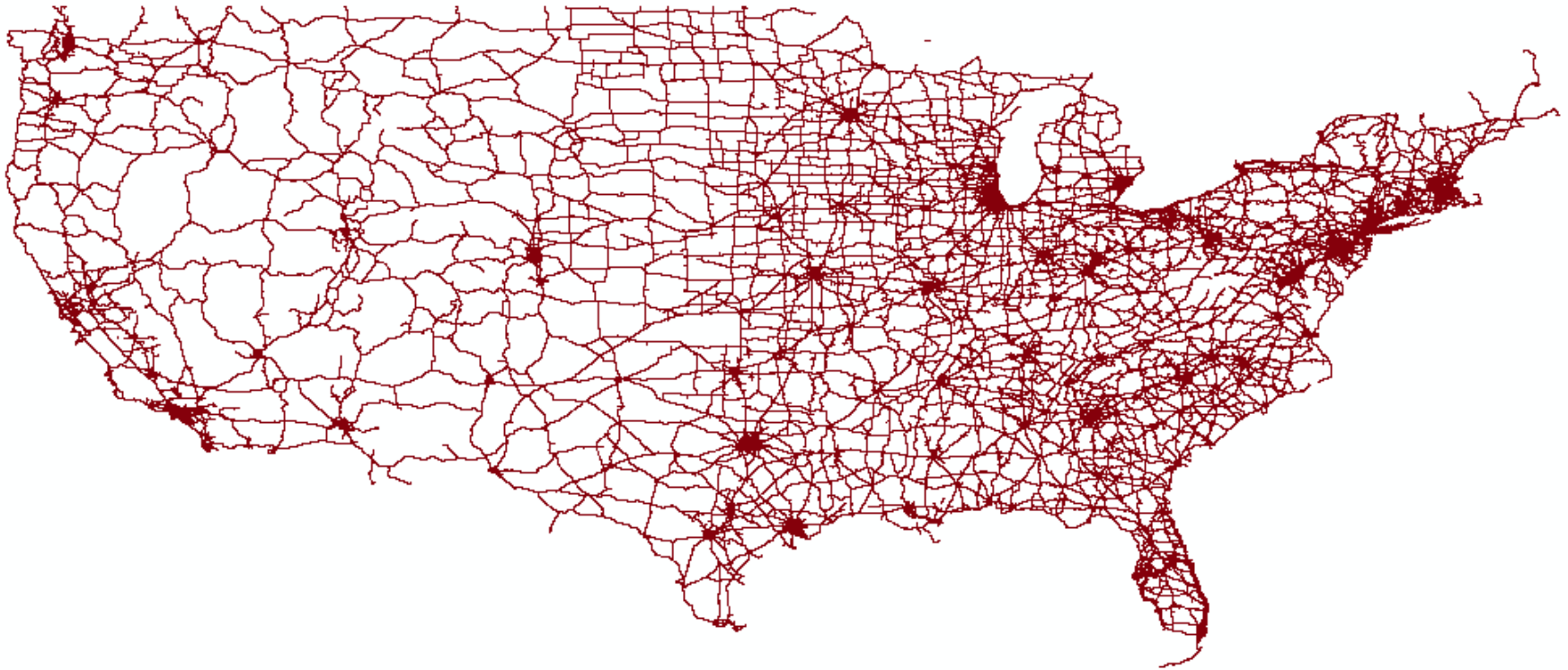


401,000 TMCs, Average length = 1.2 Miles

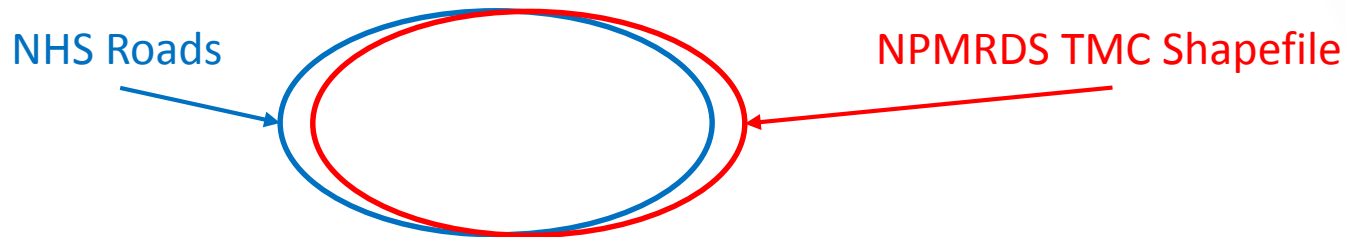
Maximum = 85.7 miles; Minimum = 0.00217 mile (= 11.45 feet)



TMCs on NHS



NPMRDS Coverage for NHS



- NHS Roads not in TMC Shapefile
 - NHS roads not coded with TMC
 - NHS roads coded with TMC but not in TMC shapefile
- NPMRDS TMC Shapefile
 - Not NHS roads
 - NHS roads
 - A TMC is partially NHS
 - No speed/travel time data in a year
 - Few speed/travel time observations in a year



Example of Data Downloaded

- Beltway-20170821-0827.zip
 - Beltway-20170821-0827.csv (8 variables)
 - TMC_Identification.csv (35 variables)
 - Contents.txt (descriptive texts)
- Shapefile:
<https://npsrds.ritis.org/analytics/shapefiles>



Speed/Travel Time

(Beltway-20170821-0827.csv; 8 variables)

datasource	tmc_code	measurement_timestamp	speed	Average_speed	reference_speed	travel_time_seconds	data_density
NPMRDS (Trucks and passenger vehicles)	110P15983	8/21/2017 0:00	58	63	69	86.59	A
NPMRDS (Trucks and passenger vehicles)	110+17034	8/21/2017 0:00	62	66	75	35.52	A
NPMRDS (Trucks and passenger vehicles)	110P17035	8/21/2017 0:00		64	75		
NPMRDS (Trucks and passenger vehicles)	110-04627	8/21/2017 0:00	59	59	65	39.61	A



Speed/Travel Time Variables 1-4

Field Name	Type	Example	Data Field Description
datasource	Text	NPMRDS (Passenger vehicles)	The data set this record comes from. This field is only included in Massive Data Downloader exports when choosing to merge the data sets into a single CSV file.
tmc_code	Text	107-12541	The unique 9-digit value identifying the TMC segment.
measurement_tstamp	Date	5/1/2017 12:00:00 AM	Date of data record, in “MM/DD/YY HH:NN:SS A” format. The date is in the local time of TMC segment to which the record pertains.
speed	Number	40	Speed is recorded in mph as an integer. The harmonic average speed for all reporting vehicles on the segment.

Speed/Travel Time Variables 5-6

Field Name	Type	Example	Data Field Description
average_speed	Number	45	The historical average speed for the roadway segment for that hour of the day and day of the week in miles per hour.
reference_speed	Number	50	The calculated "free flow" mean speed for the roadway segment in miles per hour. This attribute is calculated based upon the 85th-percentile point of the observed speeds on that segment for all time periods, which establishes a reliable proxy for the speed of traffic at free-flow for that segment.

Speed/Travel Time Variables 7-8

Field Name	Type	Example	Data Field Description
travel_time_m nutes	Number	3	Travel time recorded in minutes as an integer. It is the ratio between the segment length and the harmonic average speed for all reporting vehicles on the segment.
data_density	Text	C	Data density indicator, where: A = 1 to 4 reporting vehicles B = 5 to 9 reporting vehicles C = 10 or more reporting vehicles



TMC Table (1/4)

(TMC_Identification.csv)

datasource	tmc	road	direction	intersection
NPMRDS (Passenger vehicles)	110+0 I- 4621	495	CLOCKWISE	MD-355/WISCONSIN AVE/EXIT 34
NPMRDS (Passenger vehicles)	110P0 I- 4621	495	CLOCKWISE	MD-355/WISCONSIN AVE/EXIT 34
NPMRDS (Passenger vehicles)	110+0 I- 4622	495	CLOCKWISE	MD- 185/CONNECTICUT AVE/EXIT 33
NPMRDS (Passenger vehicles)	110P0 I- 4622	495	CLOCKWISE	MD- 185/CONNECTICUT AVE/EXIT 33



TMC Table (2/4)

(TMC_Identification.csv; 35 variables)

state	county	zip	start_la titude	start_lon gitude	end_lat itude	end_lon gitude	miles
MD	MONTGOMERY	20814	39.0179 902	77.1035 57	39.016 3226	77.0992 484	0.260 715
MD	MONTGOMERY	20814	39.0163 226	77.0992 484	39.015 7582	77.0973 526	0.108 982
MD	MONTGOMERY	20814	39.0157 582	77.0973 526	39.005 0902	77.0815 75	1.159 969
MD	MONTGOMERY	20815	39.0050 902	77.0815 75	39.005 8568	77.0740 168	0.409 751



TMC Table (3/4)

(TMC_Identification.csv; 35 variables)

road_order	timezone_name	tmcli_near	frc	borde_r_set	f_sys_tem	urban_code	facilt_ype	struct_ype	thrul_anes	route_numb
1	America/New_York	110	1	N	1	92242	2	0	7	495
2	America/New_York	110	1	N	1	92242	2	0	8	495
3	America/New_York	110	1	N	1	92242	2	0	8	495
4	America/New_York	110	1	N	1	92242	2	0	8	495



TMC Table (4/4)

(TMC_Identification.csv; 35 variables)

route _sign	route_ qual	altrten ame	aadt	aadt_si ngl	aadt_co mbi	nhs	nhs_ pct	strhnt _typ	strhnt _pct	tru ck
2	1	495	128749	5563	5142	1	100	1	100	1
2	1	495	212690	12422	5871	1	100	1	100	1
2	1	495	212690	12422	5871	1	100	1	100	1
2	1	495	220218	13155	5819	1	100	1	100	1



TMC Variables

No.	TMC Original	No.	Conflated HPMS
1	datasource	18	border_set
2	tmc	19	f_system
3	road	20	urban_code
4	direction	21	faciltype
5	intersection	22	structype
6	state	23	thrulanes
7	county	24	route_num
8	zip	25	route_sign
9	start_latitude	26	route_qual
10	start_longitude	27	altrtename
11	end_latitude	28	aadt
12	end_longitude	29	aadt_singl
13	miles	30	aadt_combi
14	road_order	31	nhs
15	timezone_name	32	nhs_pct
16	tmclinear	33	strhnt_typ
17	frc	34	strhnt_pct
		35	truck



TMC Original Variables: 1-5

Attribute Label	Attribute Description
datasource	The data set this record comes from. This field is only included in Massive Data Downloader exports when choosing to merge the data sets into a single CSV file.
tmc	The unique 9-digit value identifying the TMC Segment.
road	The roadway number, for TMC Segments on numbered roadways.
direction	the route number or common name of the roadway
intersection	the cross street and/or interchange associated with the TMC segment



TMC Original Variables: 6-12

Attribute Label	Attribute Description
state	the postal abbreviation of the state to which the TMC Segment is assigned
county	County name
zip	Zip code
start_latitude	the latitude of the beginning of the TMC segment
start_longitude	the longitude of the beginning of the TMC segment
end_latitude	the latitude of the end of the TMC segment
end_longitude	the longitude of the end of the TMC segment



TMC Original Variables: 13-17

Attribute Label	Attribute Description
miles	the length of the TMC segment
road_order	a numerical value indicating in what order the TMC segment would be encountered when traveling downstream relative to the other TMC segments on the same road
Timezone_name	Local time zone name
tmclinear	a reference to the "Linear TMC" that includes the TMC Segment. Typically, several TMC Segments are part of a Linear TMC, which usually represents a road corridor through a single county. The purpose of this column is to provide assistance for filtering and locating TMC Segments and simplifying the process of linking consecutive TMC Segments.
frc	the class or group of roads to which the road belongs (assigned by TMC Consortium)

Conflated HPMS Variables: 18-19

Attribute Label	Attribute Description
Border_set	a code to indicate whether the TMC path is within a 5-mile radius of the FHWA-designated US-Canada and US-Mexico border crossings (Y=Yes, N=No)
F_system	<p>The FHWA-approved Functional Classification System code. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the value for the highest functional class (minimum code value) is assigned.</p> <ol style="list-style-type: none"><li data-bbox="498 932 780 975">1. Interstate<li data-bbox="498 1001 1707 1043">2. Principal Arterial – Other Freeways and Expressways<li data-bbox="498 1069 1112 1112">3. Principal Arterial – Other<li data-bbox="498 1138 877 1180">4. Minor Arterial<li data-bbox="498 1206 909 1249">5. Major Collector<li data-bbox="498 1275 909 1318">6. Minor Collector<li data-bbox="498 1343 683 1386">7. Local

Conflated HPMS Variables: 20-21

Attribute Label	Attribute Description
urban_code	<p>The U.S. Census Urban Area Code. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.</p> <p>< 999998 — The US Census Urban Area code 99998 — Small Urban Sections 99999 — Rural Area Sections</p>
faciltype	<p>The operational characteristic of the roadway. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.</p> <ol style="list-style-type: none"><li data-bbox="479 1025 962 1072">1. One-Way Roadway<li data-bbox="479 1090 962 1138">2. Two-Way Roadway<li data-bbox="479 1156 672 1203">3. Ramp<li data-bbox="479 1222 846 1269">4. Non Mainline<li data-bbox="479 1288 1070 1335">5. Non Inventory Direction<li data-bbox="479 1353 911 1400">6. Planned/Unbuilt

Conflated HPMS Variables: 22-23

Attribute Label	Attribute Description
structype	<p>Code for roadway section that is a bridge, tunnel or causeway. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.</p> <ol style="list-style-type: none">1. Bridge2. Tunnel3. Causeway
thrulanes	<p>The number of lanes designated for through-traffic in BOTH TRAVEL DIRECTIONS. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.</p>



Conflated HPMS Variables: 24-27

Attribute Label	Attribute Description
route_num	The signed route number. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
route_sign	Code for the type of route signing. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
route_qual	Code for the route signing descriptive qualifier. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.
altrtename	A familiar, non-numeric designation for a route. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.

Conflated HPMS Variables: 28-30

Attribute Label	Attribute Description
aadt	Annual Average Daily Traffic. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the length-weighted average is assigned.
aadt_single	Annual Average Daily Traffic for single-unit trucks and buses. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the length-weighted average is assigned.
addt_combi	Annual Average Daily Traffic for Combination Trucks. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the length-weighted average is assigned.



Conflated HPMS Variables: 31-33

Attribute Label	Attribute Description
nhs	Code for a roadway that is a component of the National Highway System (NHS). If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant "on-NHS" value (i.e., 1 through 9) by length is assigned.
nhs_pct	The percentage of the TMC path length that is designated as NHS by HPMS (applicable when multiple HPMS segments assigned to a single TMC path).
strhnt_typ	Code for a roadway section that is a component of the Strategic Highway Network (STRAHNET). If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned.

Conflated HPMS Variables: 34-35

Attribute Label	Attribute Description
strhnt_pct	The percentage of the TMC path length that is designated as STRAHNET by HPMS (applicable when multiple HPMS segments assigned to a single TMC path). This attribute value is calculated by the NPMRDS Development Team and is not an HPMS attribute.
truck	Code for a roadway section that is a component of the National Truck Network (NTN) as defined by 23 CFR 658. If multiple HPMS segments with different attribute values are assigned to a single TMC path, the predominant value by length is assigned



Use Linear Reference System (LRS) to Link NPMRDS TMC and HPMS

Table 4.1: HPMS Sections File Structure

	Field Number	Field Name
Section	1	Year_Record
	2	State_Code
	3	Route_ID
	4	Begin_Point
	5	End_Point
	6	Data_Item
	7	Section_Length
	8	<i>Value_Numeric</i>
	9	<i>Value_Text</i>
	10	<i>Value_Date</i>
	11	Comments (Optional)

Italicized fields are used to report values and additional information pertaining to the data item (in Field 6).



TMC LRS Table

year_r e_c record	stat e_c ode	route_i d	begin_po int	end_poi nt	data _ite m	secti on_le ngth	value _num eric	value _text	valu e_da te	com men ts
2015	37	10000 02610	28.574	29.167	TMC	0.593	0	125-05197		
2015	37	10000 02610	25.3522	28.0122	TMC	2.66	0	125-05198		
2015	37	10000 02610	20.7391	24.8473	TMC	4.108 2	0	125-05199		
2015	37	10000 02610	19.2246	20.5218	TMC	1.297 2	0	125-05200		
2015	37	10000 02610	0	0.3336	TMC	0.333 6	0	125-10243		
2015	37	10000 02610	28.0122	28.244	TMC	0.231 8	0	125N05198		



After TMC is Linearly Referenced to Route ID

- Any HPMS data items can be linked to TMC
- Other linearly referenced data can be linked to TMC
- Facilitate a whole new level of integration and application of TMC-based vehicle probe data
 - NPMRDS v2
 - Other vehicle probe data
- Linearly referenced TMCs will be available by March 2018



Part 2

NPMRDS FOR PM3



Upcoming FHWA Guidance

- HPMS Field Manual Supplemental Guidance
 - Report PM3 Metrics and related data into HPMS
- FHWA Operating Procedure for Processing Travel Time Based and Percent Non-SOV Travel Measures
 - Methods to calculate PM3 Measures
- FHWA guidance on handling NPMRDS and other required data
- FHWA guidance on submitting State Biennial Performance Report
- Others



TPM Performance Measures

Safety	490.207	(a)	(1)	Number of fatalities	1
			(2)	Rate of fatalities per 100 million Vehicle Miles Traveled (VMT)	2
			(3)	Number of serious injuries	3
			(4)	Rate of serious injuries per 100 million VMT	4
			(5)	Number of non-motorized fatalities and non-motorized serious injuries	5
Pavement	490.307	(a)	(1)	Percentage of pavements of the Interstate system in Good condition	6
			(2)	Percentage of pavements of the Interstate system in Poor condition	7
			(3)	Percentage of pavements of the non-Interstate NHS in Good condition	8
			(4)	Percentage of pavements of the non-Interstate NHS in Poor condition	9
Bridge	490.407	(c)	(1)	Percentage of NHS bridges classified as in Good condition	10
			(2)	Percentage of NHS bridges classified as in Poor condition	11
Reliability	490.507	(a)	(1)	Percent of person-miles traveled on the Interstate that are reliable	12
			(2)	Percent of person-miles traveled on the non-Interstate NHS that are reliable	13
GHG		(b)		Percent change in tailpipe CO ₂ emissions on the NHS compared to CY 2017	14
Freight	490.607			Truck Travel Time Reliability (TTTR) Index	15
CMAQ - Congestion	490.707	(a)		Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita	16
			(b)		Percent of Non-Single Occupancy Vehicle (SOV) Travel
CMAQ - Emissions	490.807			Total Emissions Reduction	18



NPMRDS Supports Four PM3 Measures

- Reliability (2)
 - Percent of person-miles traveled on the Interstate that are reliable
 - Percent of person-miles traveled on the non-Interstate NHS that are reliable
- Freight (1)
 - Truck Travel Time Reliability (TTTR) Index
- CMAQ Peak Hour Excessive Delay (PHED)(1)
 - Annual Hours of PHED Per Capita

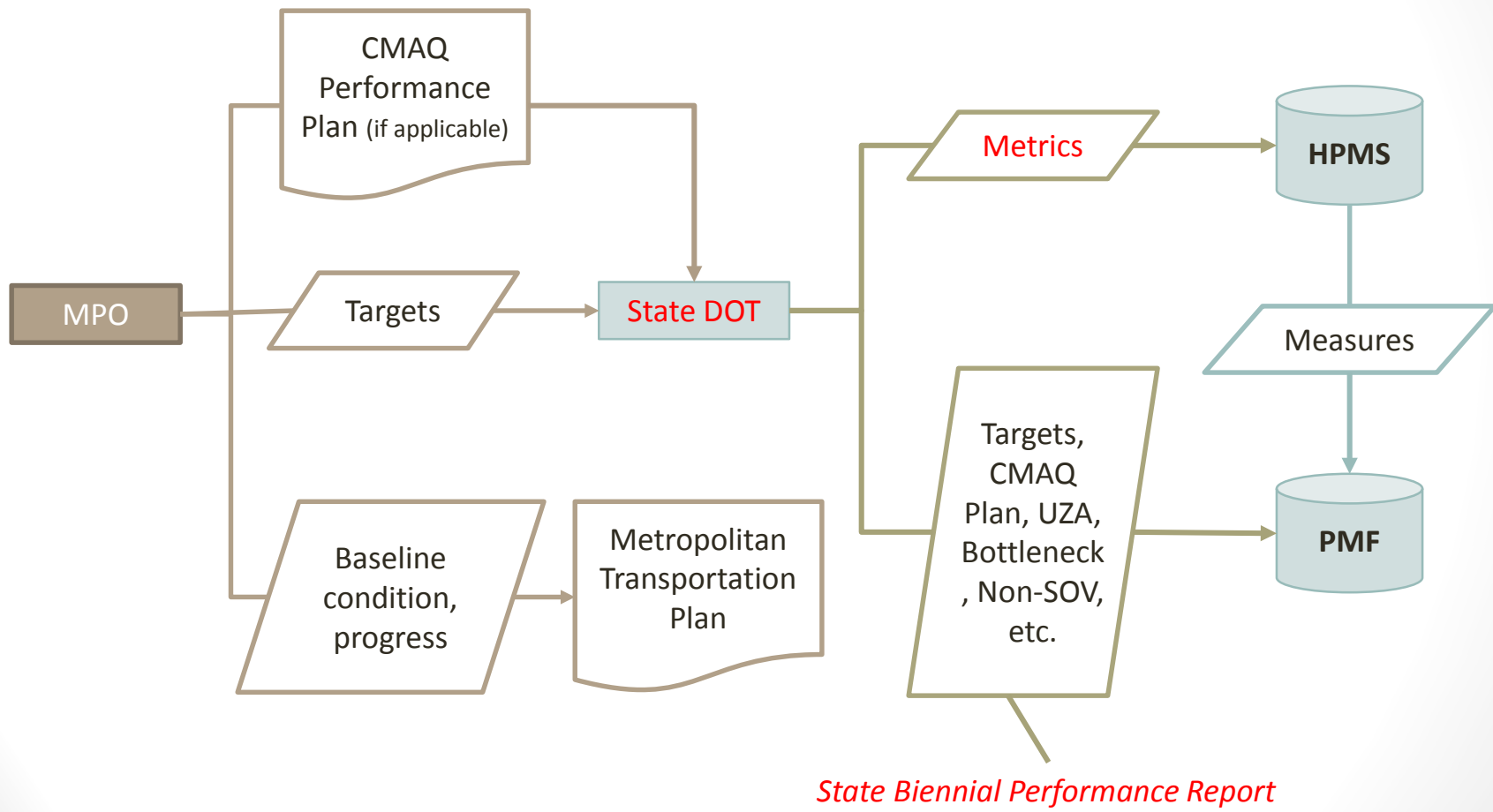


Summary of Travel Time Based 4 Measures

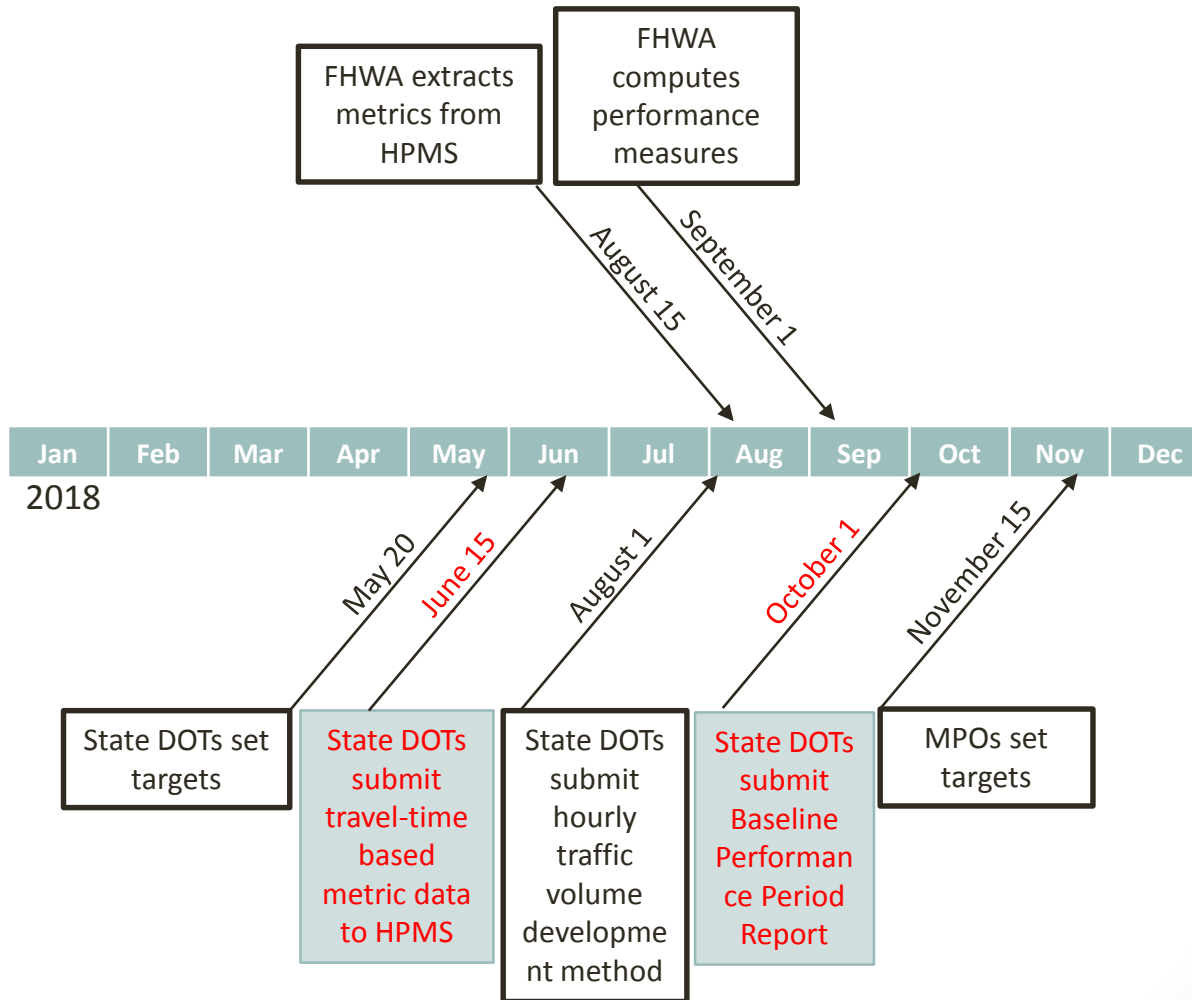
Measure	Applicability	If NPMRDS Used	Metrics to HPMS by 6/15/2018	State to Set Targets by 5/20/2018
Reliability – Interstate	Mainline Interstate	“All Vehicle”, 15-minute	LOTTR (=80 th TT/50 th TT)	2-year, 4 -year
Reliability – Non-Interstate NHS	Mainline non-Interstate NHS	“All Vehicle”, 15-minute	LOTTR (=80 th TT/50 th TT)	4-year
Freight	Mainline Interstate	“Truck” (use “All Vehicle” if “Truck” not available), 15-minute	TTTR = (95 th TT/50 th TT)	2-year, 4 -year
PHED	Mainline NHS in applicable Urbanized Area	“All Vehicle”, 15-minute	Total PHED in person-hours	4-year



MPO and State TPM Reporting



2018 Timeline



Travel Time Related Metrics to HPMS by June 15, 2018

Performance Measures	Segment-Level Performance Metrics	Number of Metrics*
Reliability (Interstate, non-Interstate NHS)	1. LOTTR 2. 80 th Travel Time 3. 50 th Travel Time 4. Directional AADT 5. Occupancy factor } x 4 time periods	14
Freight	1. TTTR 2. 95 th Travel Time 3. 50 th Travel Time } x 5 time periods	15
PHED	1. PHED	1

* There are other Metrics related data to be submitted to HPMS. Refer to *HPMS Field Manual Supplemental Guidance for a full list.*



Reliability

- **Interstate Travel Time Reliability Measure:**
Percent of person-miles traveled on the Interstate that are reliable
- **Non-Interstate Travel Time Reliability Measure:**
Percent of person-miles traveled on the non-Interstate NHS that are reliable



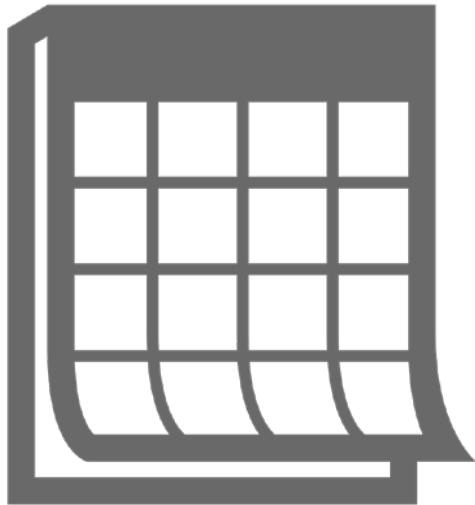
Data Requirements: Reliability

Relevant Data	Data Source(s)
<ul style="list-style-type: none">• Travel times• NHS travel time segments	<ul style="list-style-type: none">• National Performance Management Research Data Set (NPMRDS) , OR• Equivalent data set
<ul style="list-style-type: none">• AADT/volumes• Annual traffic volume (AADT x 365)	<ul style="list-style-type: none">• Highway Performance Monitoring System (HPMS)
<ul style="list-style-type: none">• Occupancy factors	<ul style="list-style-type: none">• Provided by FHWA, likely based on national surveys, OR• Other allowed data sources



Applicable Time Periods: Reliability

Full Year (Jan 1-Dec 31)



Weekdays
(Mon – Fri)

6 – 10am

10am – 4pm

4 – 8pm

Weekends

6am –
8pm

Total Four Time Periods



Calculate LOTTR Metric

- Download “all vehicle” 15-minute travel time data from NPMRDS v2
- Group data into 4 time periods for each TMC
 - Weekday 6:00-10:00 am
 - Weekday 10:00 am-4:00 pm
 - Weekday 4:00-8:00 pm
 - Weekend 6:00 am-8:00 pm
- Rank travel times in each group to obtain 80th and 50th travel times for each TMC
- $LOTTR = 80^{th} \text{ travel time} / 50^{th} \text{ travel time}$ for each TMC



Level of Travel Time Reliability (LOTRR) Metric (Example)

$$\frac{\text{Longer Travel Time (80th)}}{\text{Normal Travel Time (50th)}} = \frac{\# \text{ seconds}}{\# \text{ seconds}} = \text{Level of Travel Time Reliability Ratio}$$

Level of Travel Time Reliability (LOTRR) (Single Segment, Interstate Highway System)		
Monday – Friday	6am – 10am	LOTRR = $\frac{44 \text{ sec}}{35 \text{ sec}} = 1.26$
	10am – 4pm	LOTRR = 1.39
	4pm – 8pm	LOTRR = 1.54
Weekends	6am – 8pm	LOTRR = 1.31
Must exhibit LOTTR below 1.50 during <u>all</u> of the time periods		Segment is <u>not</u> reliable

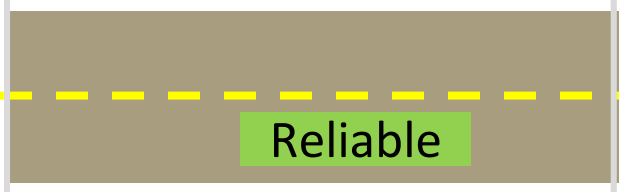
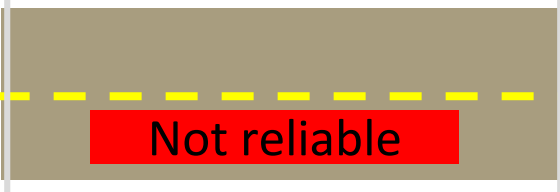


HPMS Submittal: Reliability

Starting in 2018, State DOTs report **LOTTR** metrics and the corresponding **80th** and **50th** percentile times for each time period and **directional AADT** for each reporting segment by June 15 of each year, for the previous year's measures



Calculating Travel Time Reliability Measures (Example)

		
Length	1.000 mi.	0.750 mi.
Annual Traffic Volume	2,000,000	3,500,000
	x	x
Occupancy Factor	x 1.3 persons/vehicle	x 1.7 persons/vehicle
Segment Total	Reliable: 2,600,000 person-miles	Unreliable: 4,462,500 person-miles
	$\frac{\Sigma (\text{Reliable person-miles})}{\Sigma (\text{Total person-miles})}$	

Measure: % of person-miles reliable, for full extent of the system



Freight

- **Freight Reliability Measure:** Truck Travel Time Reliability (TTTR) Index
 - The sum of maximum TTTR for each reporting segment, divided by the total Interstate system miles



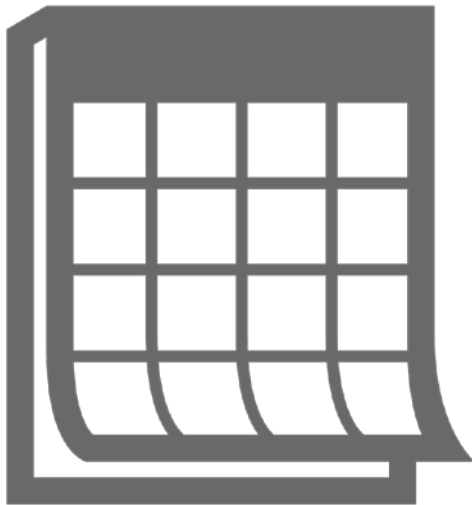
Data Requirements: Freight Reliability

Relevant Data	Data Source Options
<ul style="list-style-type: none">• Truck travel times• Interstate travel time segments	<ul style="list-style-type: none">• NPMRDS, <i>OR</i>• Equivalent data set



Applicable Time Periods: Freight

Full Year (Jan 1-Dec 31)



Weekdays
(Mon – Fri)

Weekends

6 – 10am

10am – 4pm

4 – 8pm

Overnight (all days)

8pm – 6am

6am –
8pm

Total Five Time Periods



Calculate TTTR Metric

- Download “truck” and “all vehicle” 15-minute travel time data from NPMRDS v2
- **If “truck” speed is empty, use “all vehicle” value, if available**
- Group data into 5 time periods for each TMC
 - Weekday 6:00-10:00 am
 - Weekday 10:00 am-4:00 pm
 - Weekday 4:00-8:00 pm
 - Everyday Overnight 8:00 pm-6:00 am
 - Weekend 6:00 am-8:00 pm
- Rank travel times in each group to obtain 95th and 50th travel times for each TMC
- $TTTR = 95^{\text{th}} \text{ travel time} / 50^{\text{th}} \text{ travel time}$ for each TMC



Freight Reliability Metric (Example)

$$\frac{\text{Longer Truck Travel Time (95th)}}{\text{Normal Truck Travel Time (50th)}} = \frac{\# \text{ seconds}}{\# \text{ seconds}} = \text{Truck Travel Time Reliability (TTTR) Ratio}$$

Truck Travel Time Reliability (TTTR) (Single Segment, Interstate Highway System)		
Monday – Friday	6am – 10am	TTTR = $\frac{72 \text{ sec}}{50 \text{ sec}} = 1.44$
	10am – 4pm	TTTR = 1.39
	4pm – 8pm	TTTR = 1.49
Weekends	6am – 8pm	TTTR = 1.31
Overnight	8pm – 6am	TTTR = 1.20
Maximum TTTR		1.49



HPMS Submittal: Freight

Starting in 2018, State DOTs report **TTTR** metrics and the corresponding **95th** and **50th** percentile times for each time period and each reporting segment by June 15 of each year, for the previous year's measures



Calculating Freight Reliability Measure (Example)

$$\text{TTR Index} = \frac{\sum \text{All segment length weighted TTR}}{\sum \text{All segment lengths}}$$

Segment length (mi.)	0.500	0.500	1.000	1.000	5.000
MaxTTR	1.49	1.59	1.50	1.41	1.36
Length-weighted TTR	0.75	0.80	1.50	1.41	6.80

$$\text{TTR Index} = \frac{11.25}{8.000 \text{ mi}} = 1.41$$

Measure: TTR Index, full extent of the Interstate system



Peak Hour Excessive Delay (PHED)

- Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita



Applicability: PHED

- Areas with the following criteria:

Area Characteristics

- Designated urbanized area,
- Contains NHS mileage, **AND**
- Population over 200,000*



Nonattainment or Maintenance Area

- ozone (O₃),
- carbon monoxide (CO), **OR**
- particulate matter (PM₁₀ or PM_{2.5})

- **All MPOs and State DOTs** that have NHS mileage that overlaps with an applicable urbanized area must coordinate on a **single, unified target** and report on the measures.

** Phase In: For the first performance period only, the population criteria applies to urbanized areas with populations over 1 million.*



Data Requirements: PHED

Relevant Data	Data Source Options
<ul style="list-style-type: none"> • Urbanized Area Boundary 	<ul style="list-style-type: none"> • US Decennial Census • HPMS
<ul style="list-style-type: none"> • Reporting Segment Length 	<ul style="list-style-type: none"> • NPMRDS, OR • Equivalent data set
<ul style="list-style-type: none"> • Travel Time in 15-minute intervals 	<ul style="list-style-type: none"> • NPMRDS, OR • Equivalent data set
<ul style="list-style-type: none"> • Hourly Traffic Volume 	<ul style="list-style-type: none"> • Hourly continuous traffic volume counts, OR • Derived from AADT reported to the HPMS
<ul style="list-style-type: none"> • Annual Vehicle Classification for Buses, Trucks, and Cars 	<ul style="list-style-type: none"> • Annual traffic volume counts, OR • AADT, AADT single unit, and AADT combination as reported to the HPMS
<ul style="list-style-type: none"> • Annual Vehicle Occupancy 	<ul style="list-style-type: none"> • Data provided by FHWA, OR • Alternative estimate that is more specific



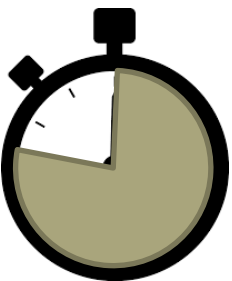
Calculate PHED Metric

- Download “all vehicle” 15-minute travel time data from NPMRDS v2
 - Only for Peak Period (weekday 6-10 am; weekday 3-7 pm or 4-8 pm)
- Determine threshold for excessive delay for each (TMC) segment
 - 20 mph, or 60% of posted speed limit, whichever is greater
 - Covert threshold speed to threshold travel time
- Calculate travel time segment delay
 - NPMRDS travel time – threshold travel time (≥ 0)
- Convert the travel time segment delay to person-hours
 - Hourly volume \div 4 (to get vehicle hours of delay)
 - Average Vehicle Occupancy (to get person-hours of delay)
 - Weighted average of occupancy factors for cars, buses, and trucks



PHED Metric (Example)

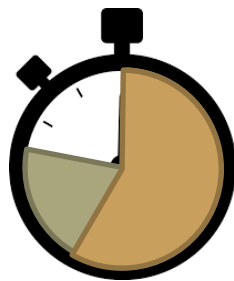
0.500 Mile Reporting Segment



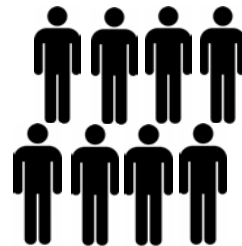
Average of **105 seconds** for a 15-min. segment per vehicle



Excessive Delay Threshold: **72 seconds**



$105 - 72 =$
33 seconds



500,000 people traveling during **peak hours** (per mode)



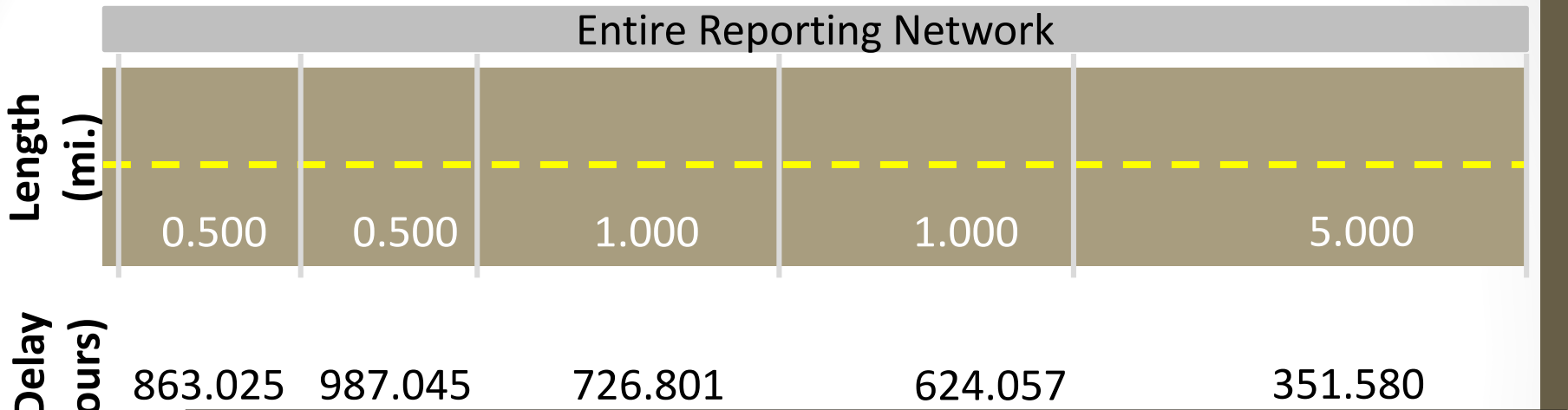
= 863.025 person-hours
For all **peak periods** in a full calendar year



**HPMS Submittal: Starting in 2018, State DOTs report PHED metric for each reporting segment by June 15 of each year, for the previous year's measures*



Calculating PHED Measure (Example)



$\frac{4.46\text{M person-hours excessive delay}}{1.05\text{M urbanized area population}}$

= 4.3 hours per capita

Measure: Peak hour excessive delay per capita



Part 3

NPMRDS FOR OTHER APPLICATIONS

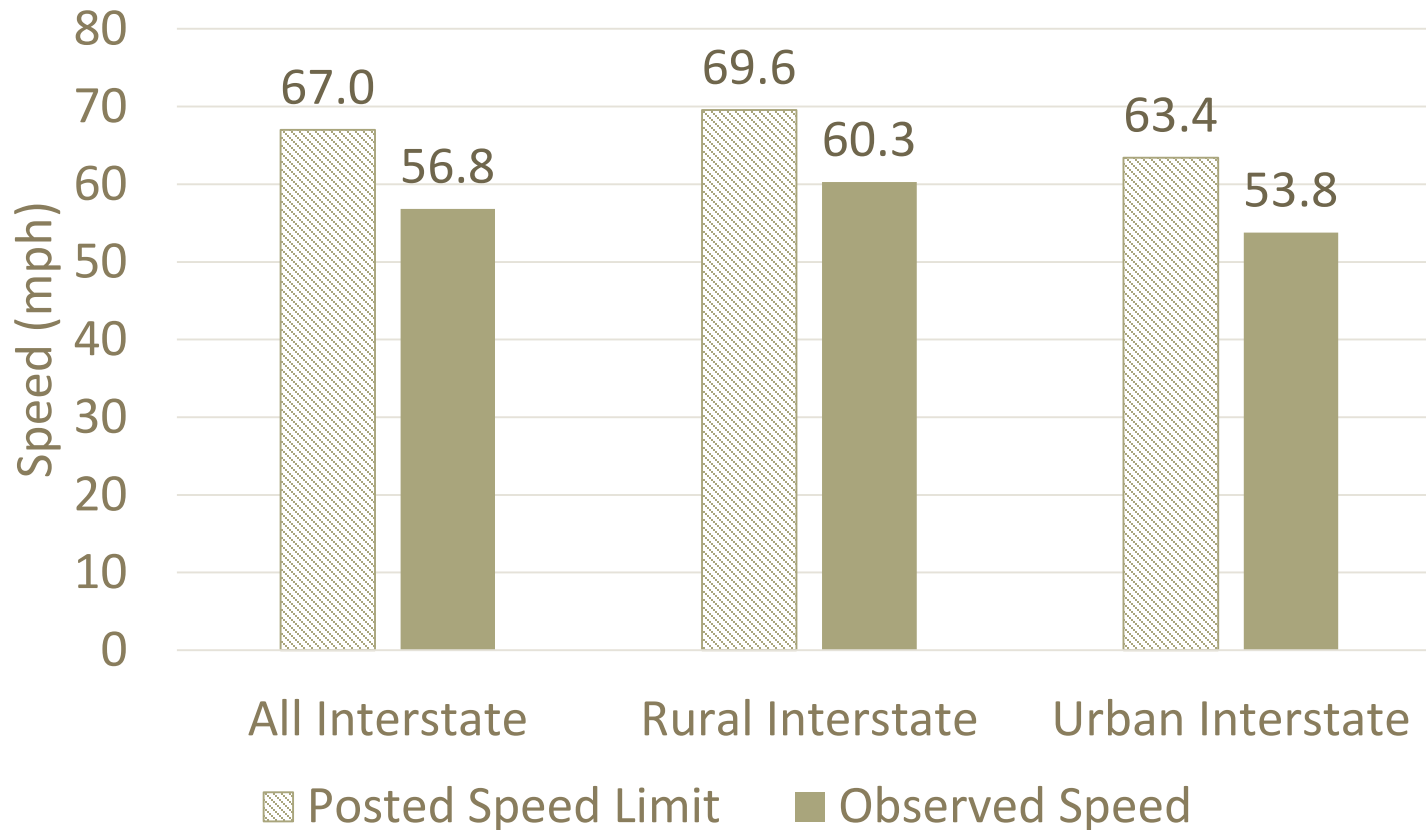


Applications

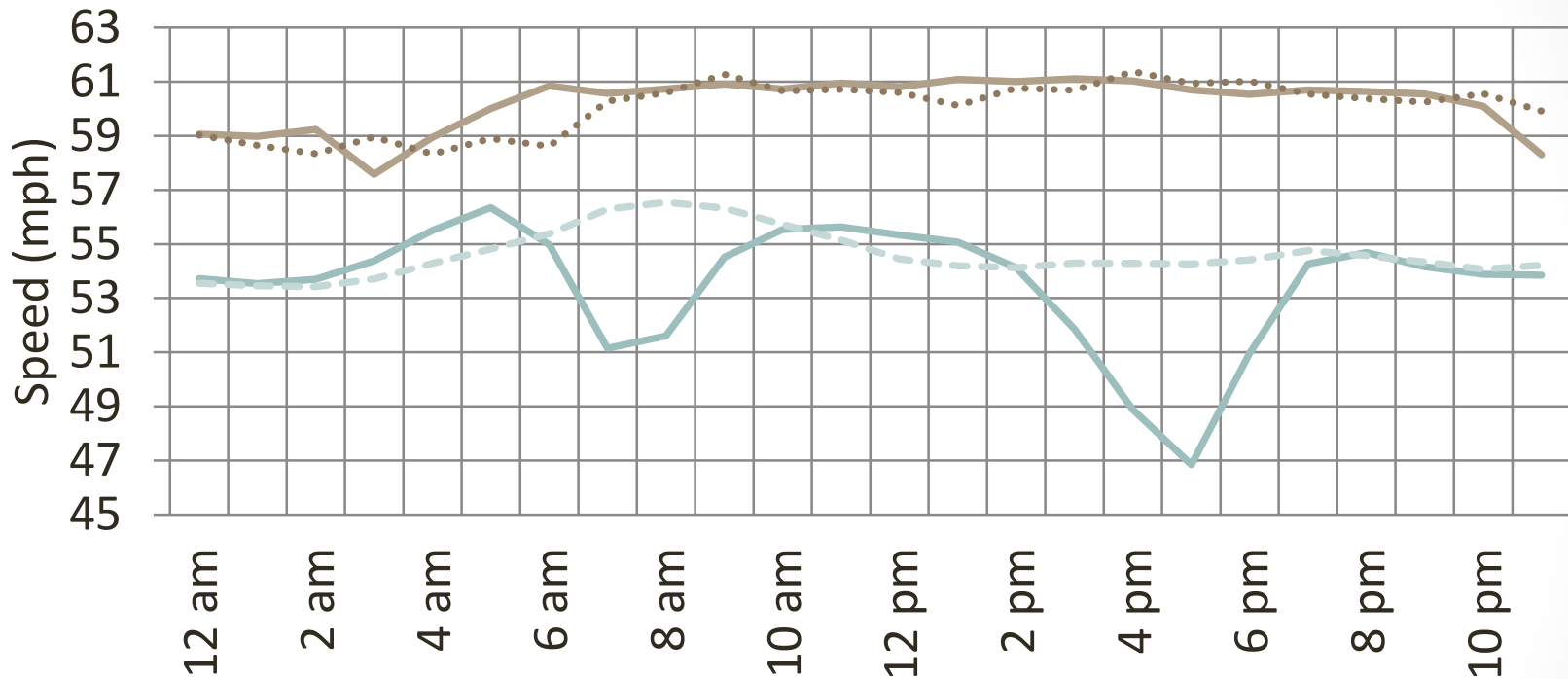
- Interstate Speed Profiles based on NPMRDS 2016 data
- Event analysis based on vehicle probe data
- Others
 - NPMRDS and safety datasets
 - NPMRDS to improve MOVES and Noise modeling
 - NPMRDS to improve travel demand models
 - NPMRDS to improve transit modeling



2016 Interstate Speed Profiles: Average Speed



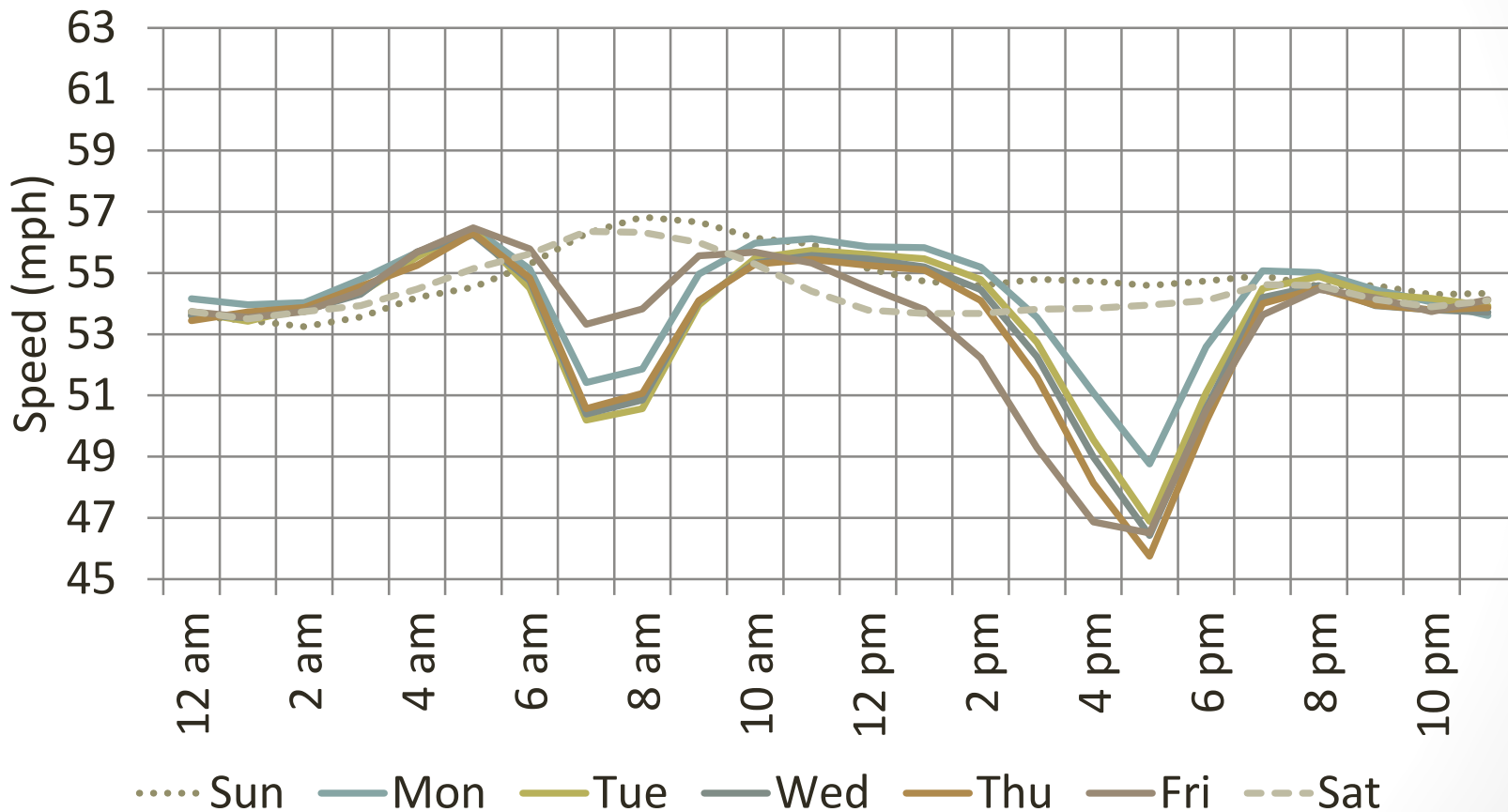
Speed by Hour of the Day



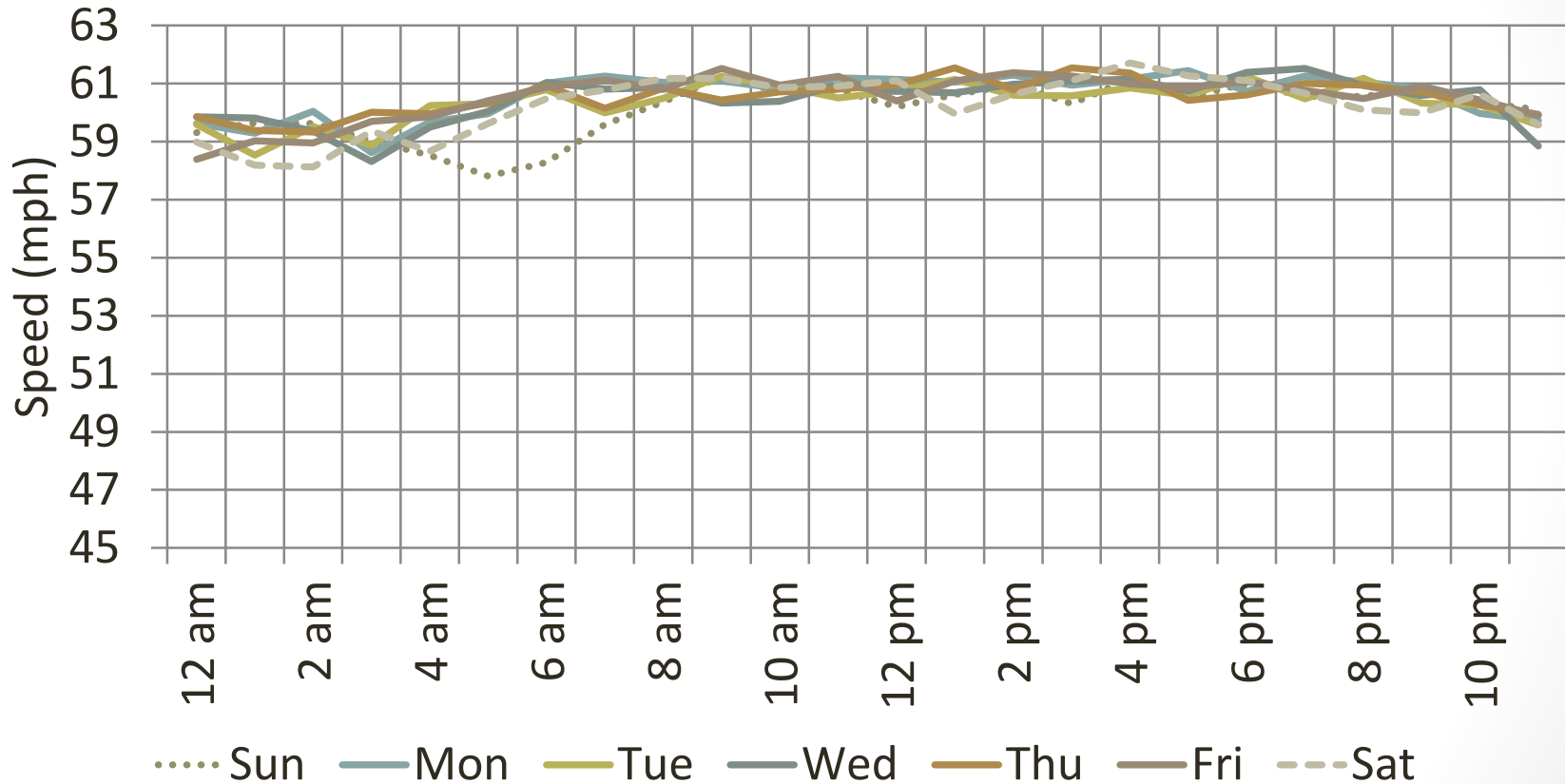
— Urban, Weekday - - - Urban, Weekend
— Rural, Weekday Rural, Weekend



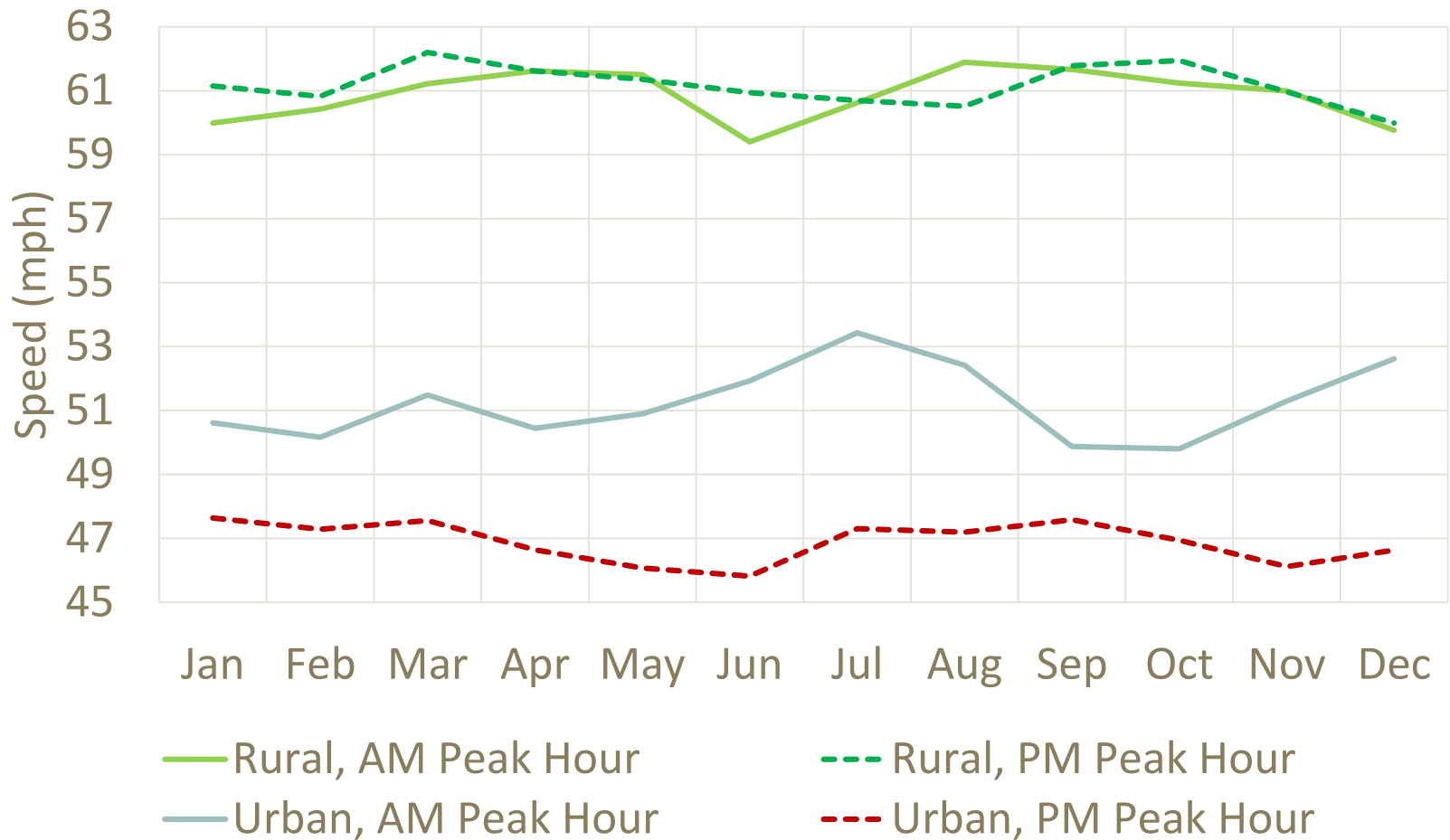
Hourly Speed Pattern by Day of the Week - Urban



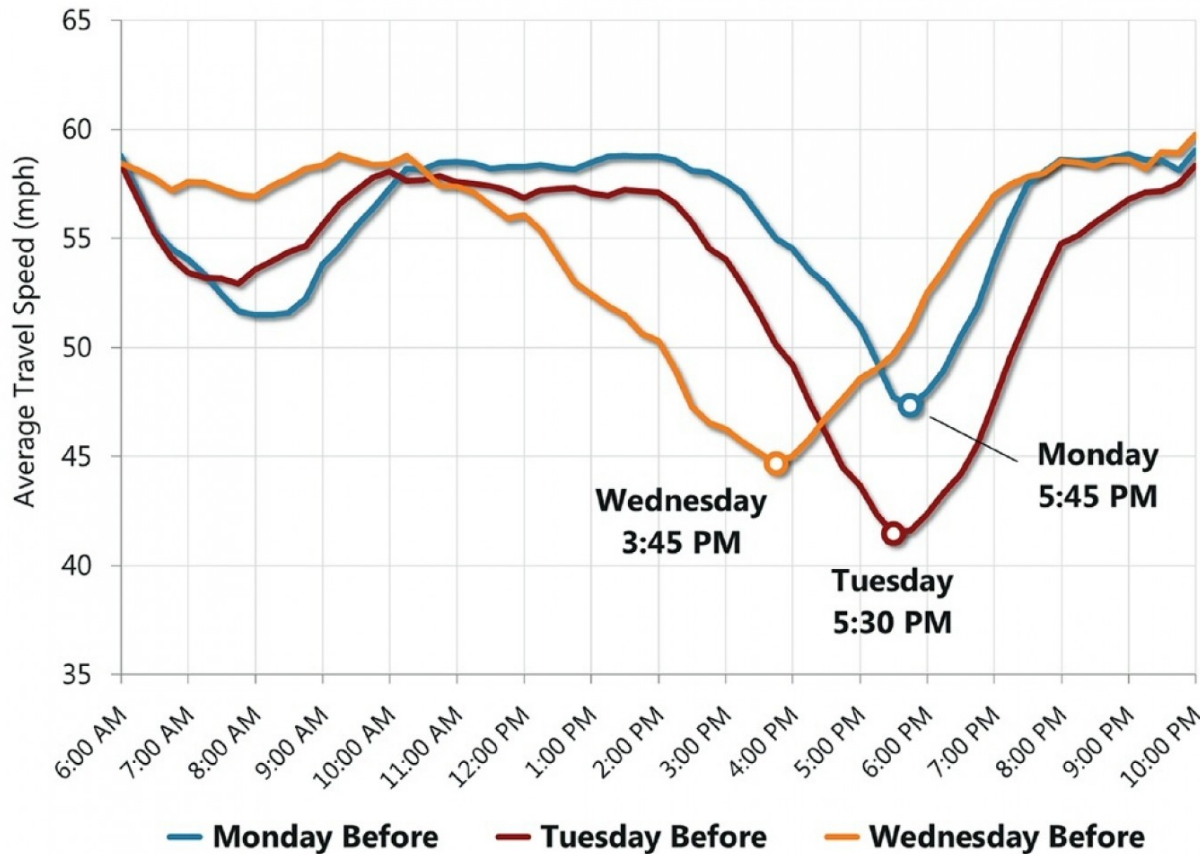
Hourly Speed Pattern by Day of the Week - Rural



Peak Hour Speed by Month



Traffic before Thanksgiving

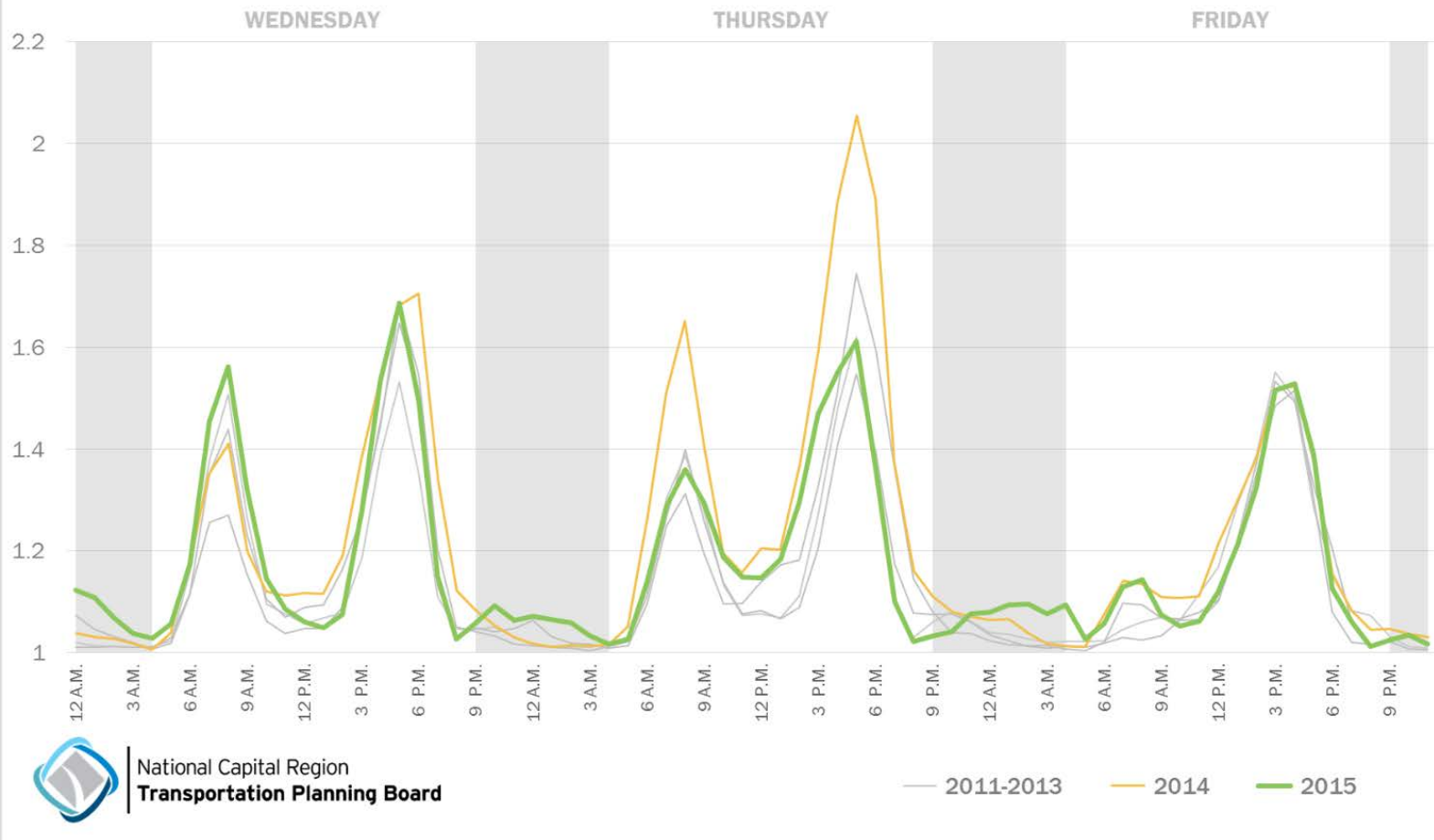


Source: MWCOG

https://www.washingtonpost.com/news/dr-gridlock/wp/2016/11/22/tuesday-wednesday-afternoons-worst-for-thanksgiving-traffic/?utm_term=.5553a12ac244



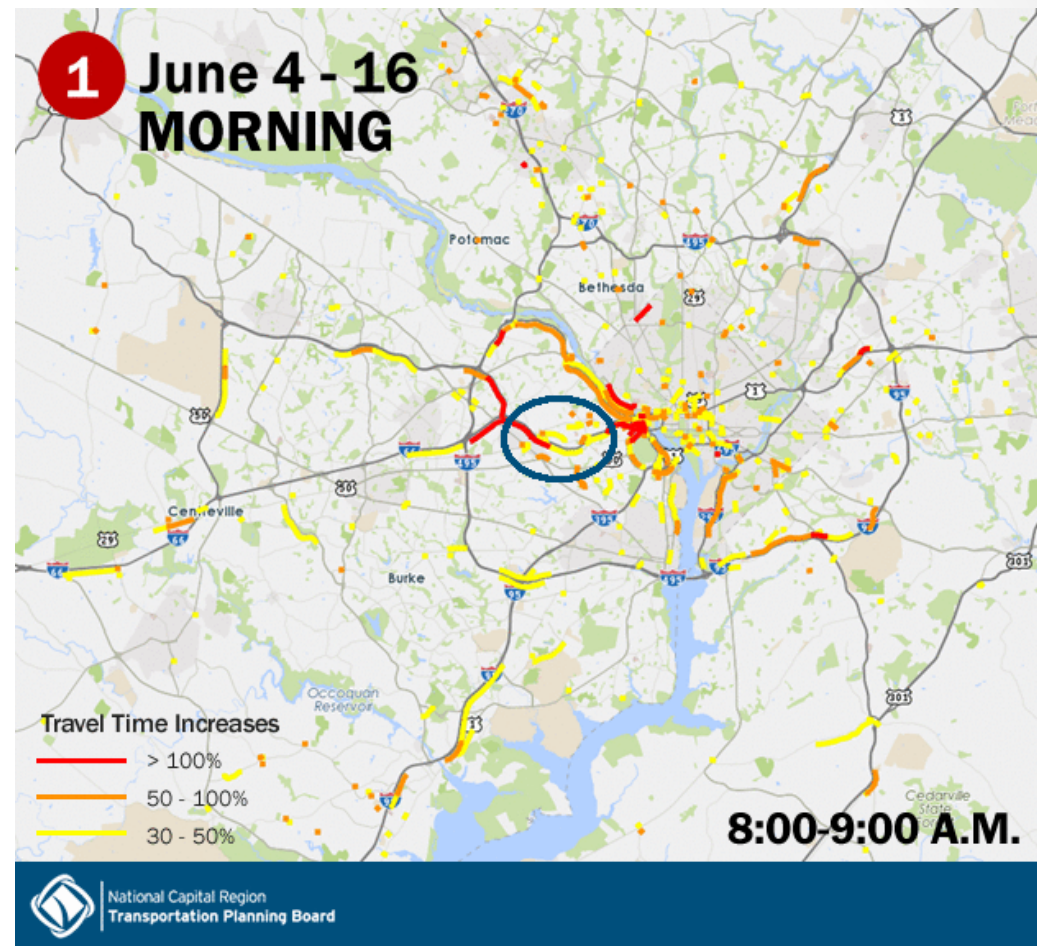
Hourly Travel Time Index (TTI) on Area Freeways in the Days Before Memorial Day Weekend



<http://www.tpbne.ws/featured/hitting-the-road-for-memorial-day-think-twice-before-leaving-thursday-afternoon/>



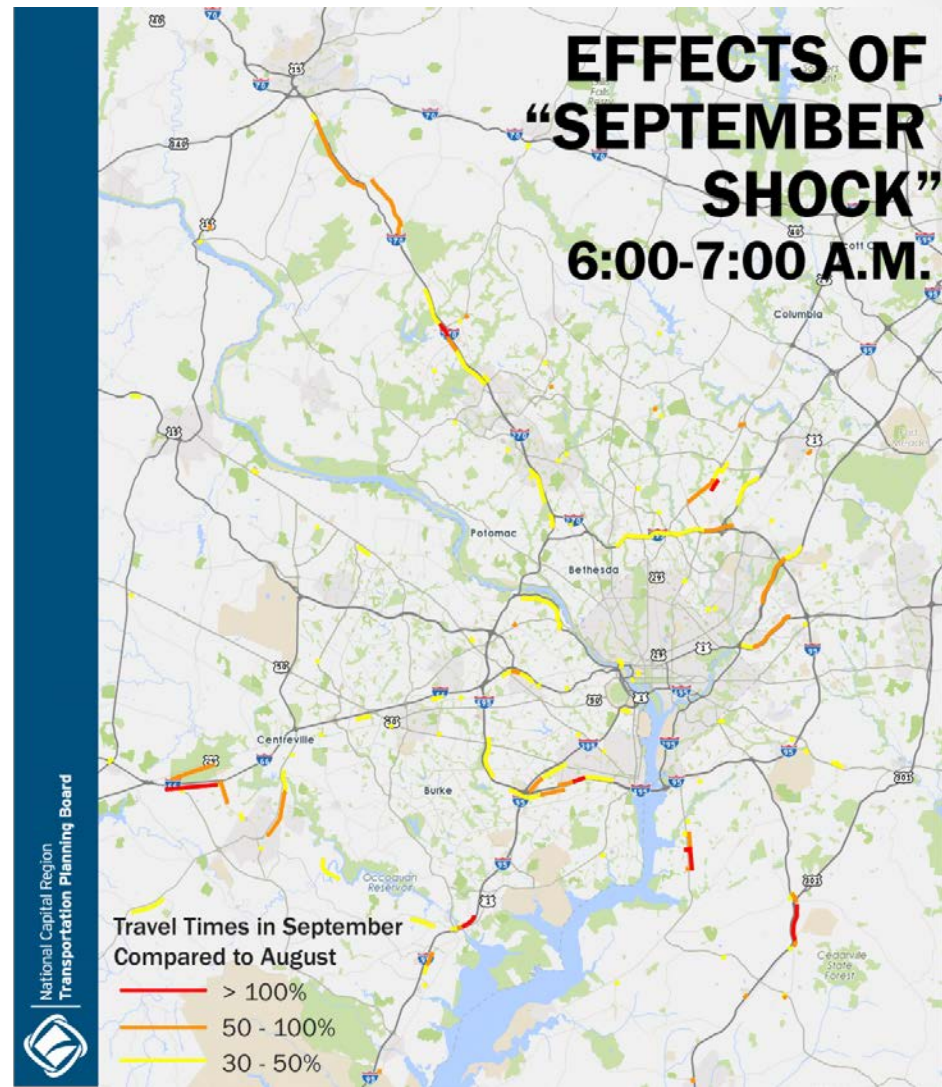
Traffic Impact of WMATA SafeTrack Short-Term Rail Repair, 2016



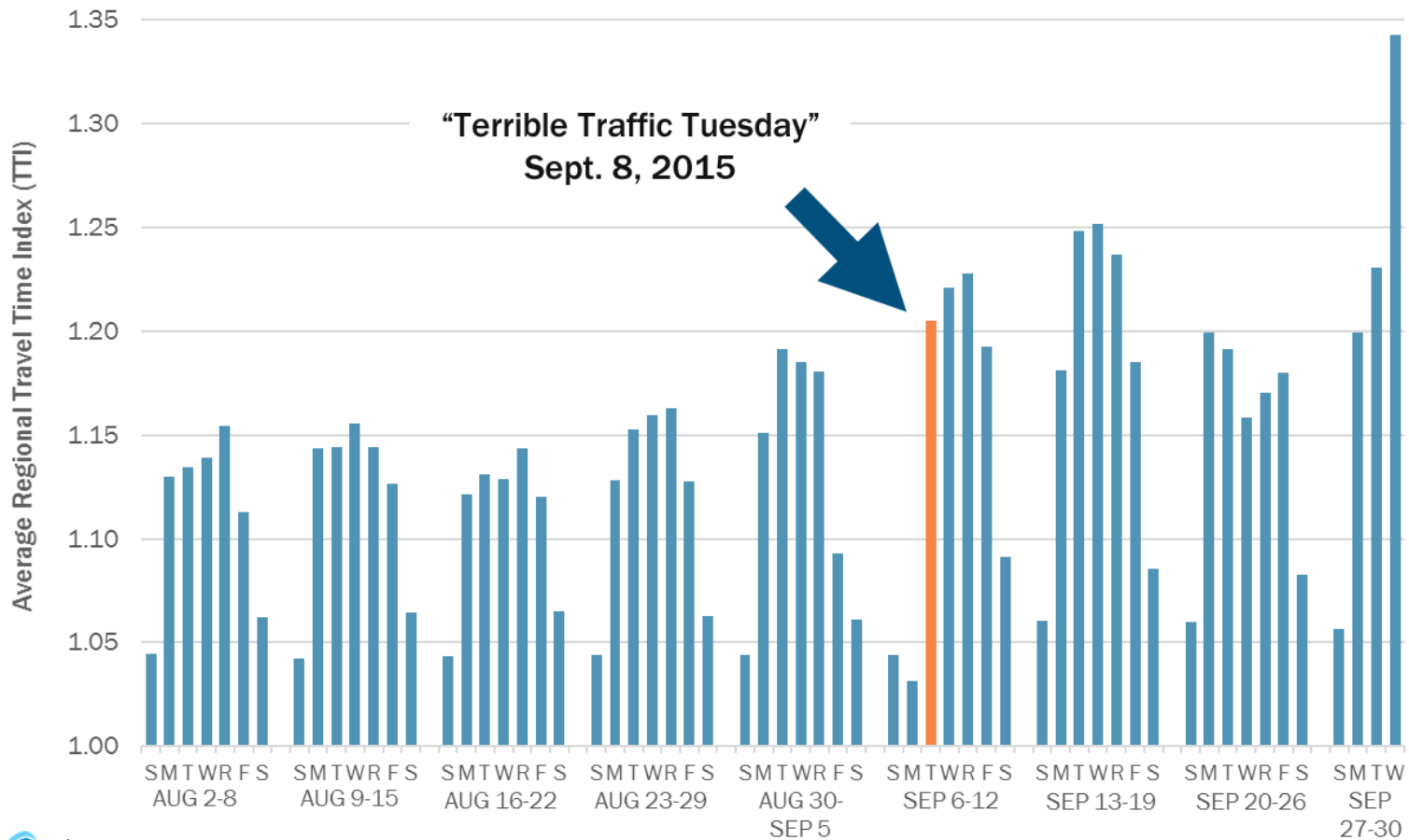
<http://www.tpbne.ws/featured/how-safetrack-has-impacted-traffic-on-area-roadways-so-far/>



<http://www.tpbne.ws/featured/get-ready-for-traffic-to-pick-back-up-as-part-of-september-shock/>



Daily Morning Traffic Conditions in August and September 2015

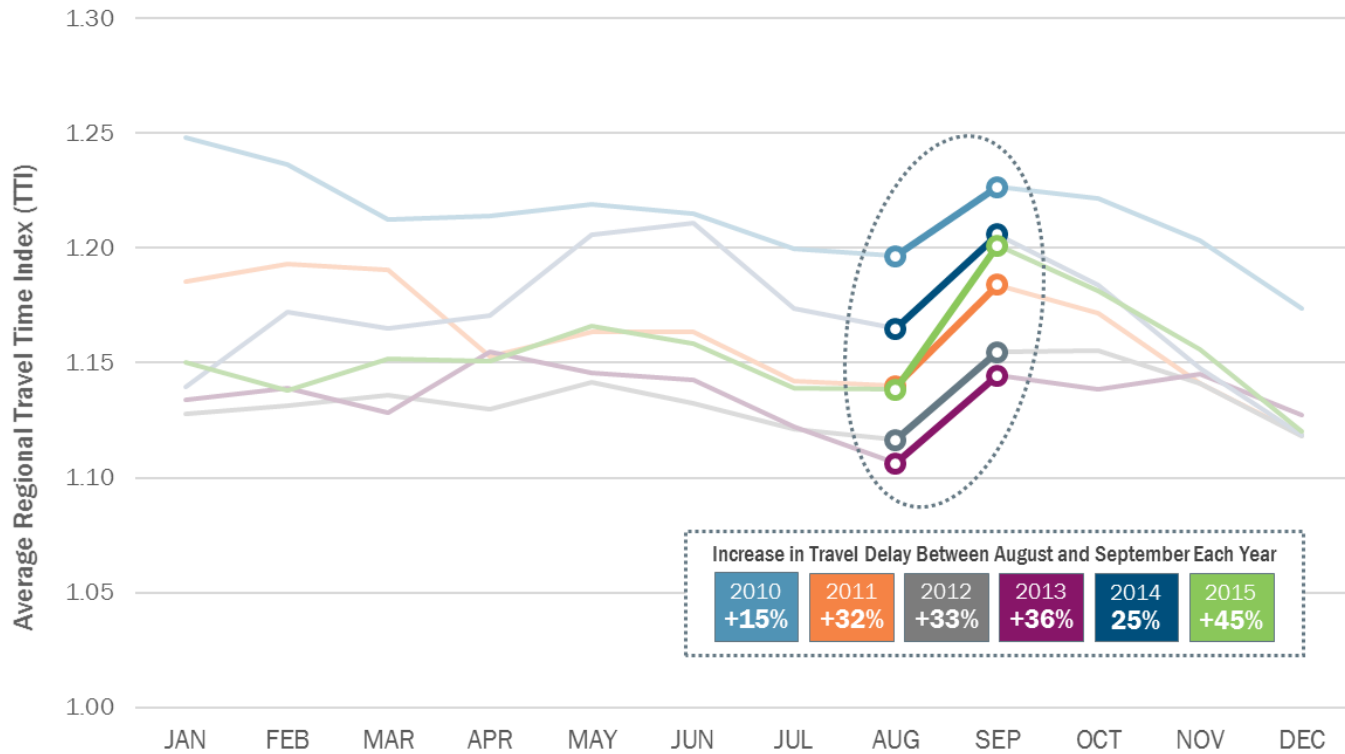


National Capital Region
Transportation Planning Board

Source: MWCOG



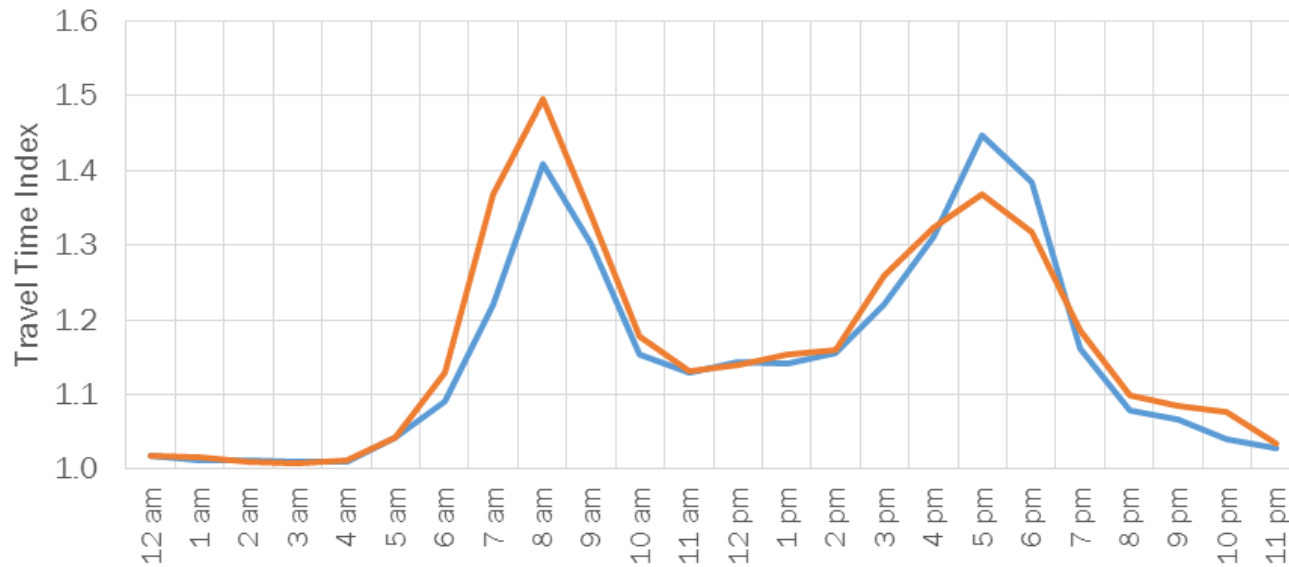
Morning Travel Delay Consistently Jumps by 15-45% Between August and September Each Year



<http://www.tpbne.ws/featured/get-ready-for-traffic-to-pick-back-up-as-part-of-september-shock/>

A Day without Metro (1/2)

Regional Core Hourly Travel Time Index (TTI)
Day of the Shutdown vs. Typical Conditions



The regional core includes the District of Columbia, Arlington, and Alexandria.



National Capital Region
Transportation Planning Board

— Typical conditions

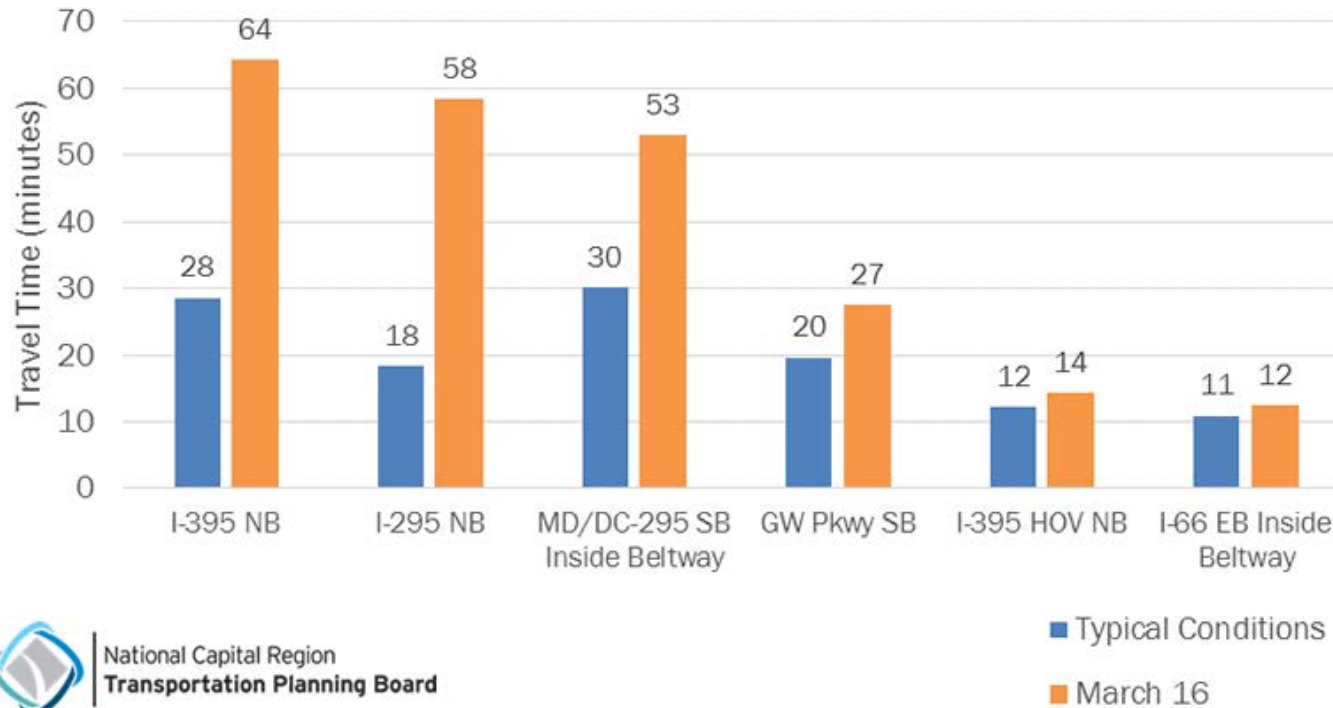
— March 16

<http://www.tpbne.ws/uncategorized/a-day-without-metro-meant-worse-traffic-for-some-but-not-others/>



A Day without Metro (2/2)

Inbound Travel Times on Freeways Inside the Beltway
During the AM Peak Hour (7:00-8:00 AM)

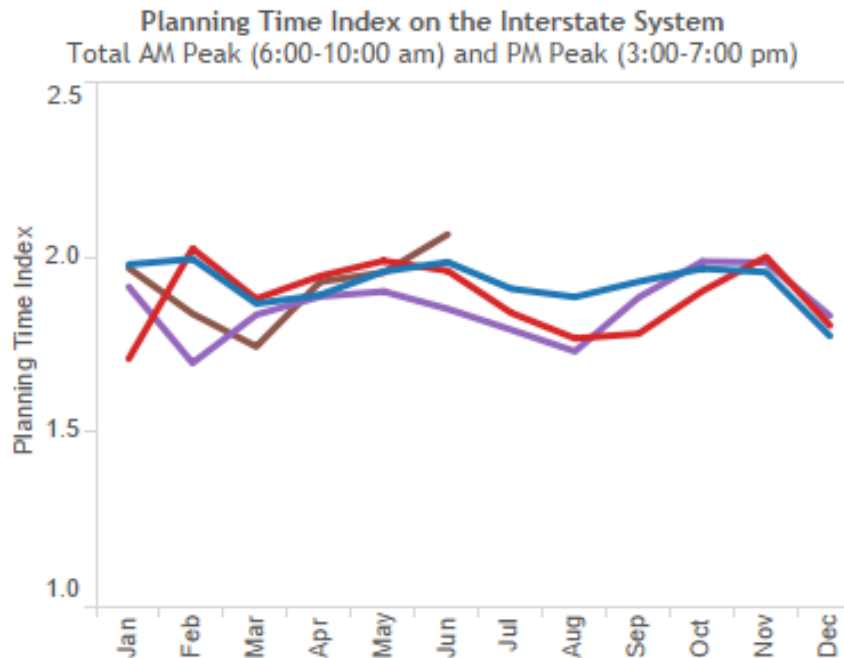
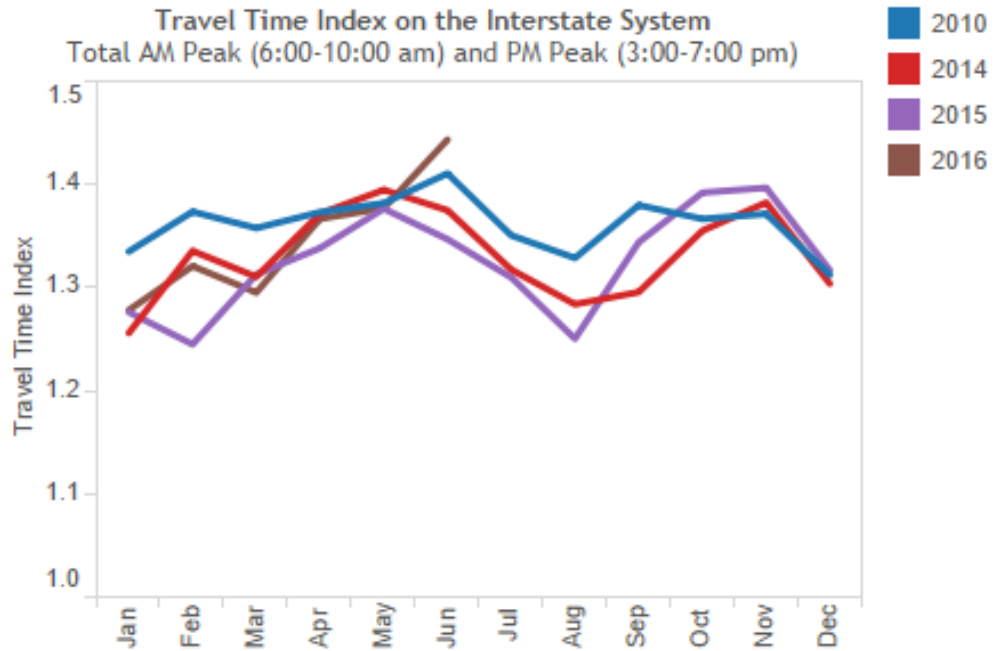


<http://www.tpbne.ws/uncategorized/a-day-without-metro-meant-worse-traffic-for-some-but-not-others/>



Congestion Dashboard

<https://www.mwcog.org/congestion/>



Questions and Comments

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